

AS1101, AS1102, AS1103, AS1104

Low-Dropout LED Drivers

Data Sheet

1 General Description

The AS1101/AS1102/AS1103/AS1104 are LED drivers designed to match current source bias for any color LED, including white and blue. The devices can drive up to 4 high-current LEDs, and the LED current is programmable using an external resistor (RSET).

The AS1101 LED currents are $460 \times I_{SET}$ (per LED, typ) at an LED cathode voltage (V_{SAT}) of 150mV and $650 \times I_{SET}$ (typ) at a V_{SAT} of 1V, where I_{SET} is the current through RSET connected to pin CTRL.

The AS1102, AS1103, and AS1104 LED currents are $230 \times I_{SET}$ (per LED, typ) at a V_{SAT} of 150mV and $325 \times I_{SET}$ (typ) at a V_{SAT} of 1V.

The AS1101, AS1102, and AS1104 incorporate a chip-enable feature via pin ON. When the devices are disabled, the supply current drops to less than $1\mu A$.

The AS1101, AS1102, and AS1103 are available in a 6-pin SC70 package; the AS1104 is available in a 8-pin MSOP package.

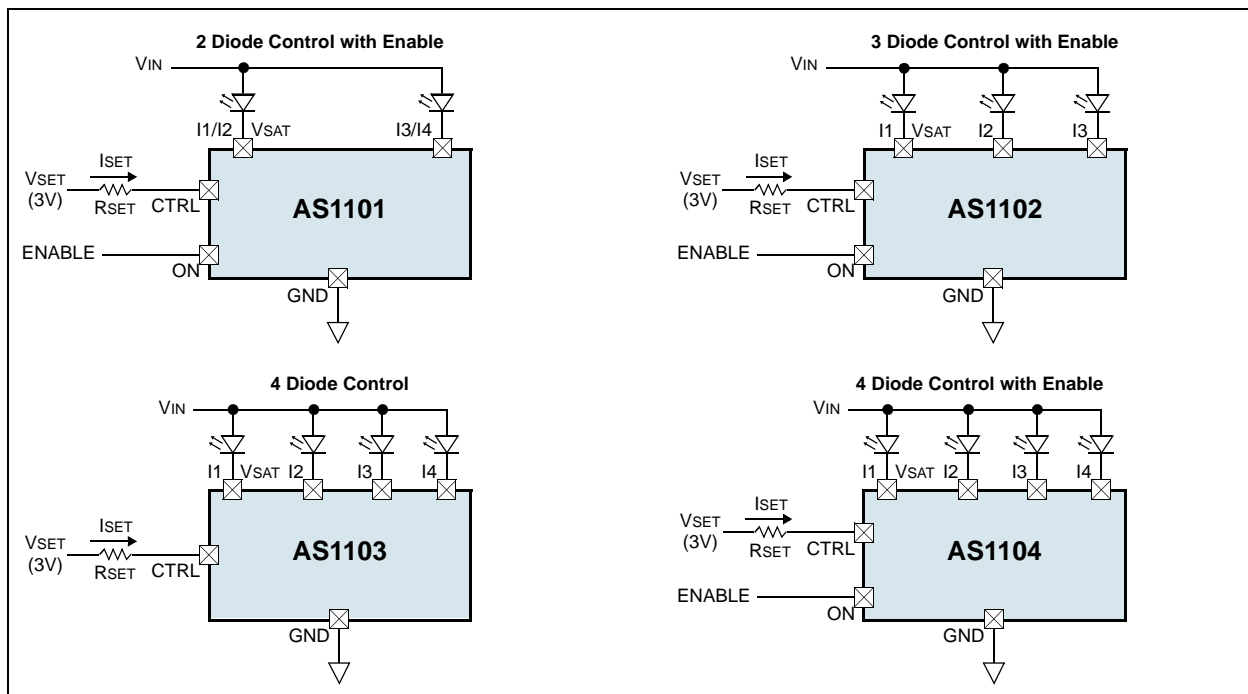
2 Key Features

- LED Drivers for Parallel-Connected LEDs
- Ultra-Low Voltage Drop: Less Than 150mV (for Li-ion Battery Support)
- Analog and PWM Brightness Control
- Up to 80mA per LED (AS1101)
- Up to 40mA per LED (AS1102, AS1103, AS1104)
- No Electromagnetic Interference, No Switching-Noise
- Current-Matching Requires No External Components
- Active-Low Shutdown Mode (AS1101, AS1102, and AS1103)
- Low Shutdown-Current: Less Than $1\mu A$
- SC70-6 Package (AS1101, AS1102, and AS1103)
- MSOP-8 Package (AS1104)

3 Applications

The AS110x devices are ideal for LED displays and keyboard backlights, as well as lighting management units for battery powered audio devices such as MP3 and CD players, mobile and cordless phones, PDAs, portable DVD players, and consumer electronics.

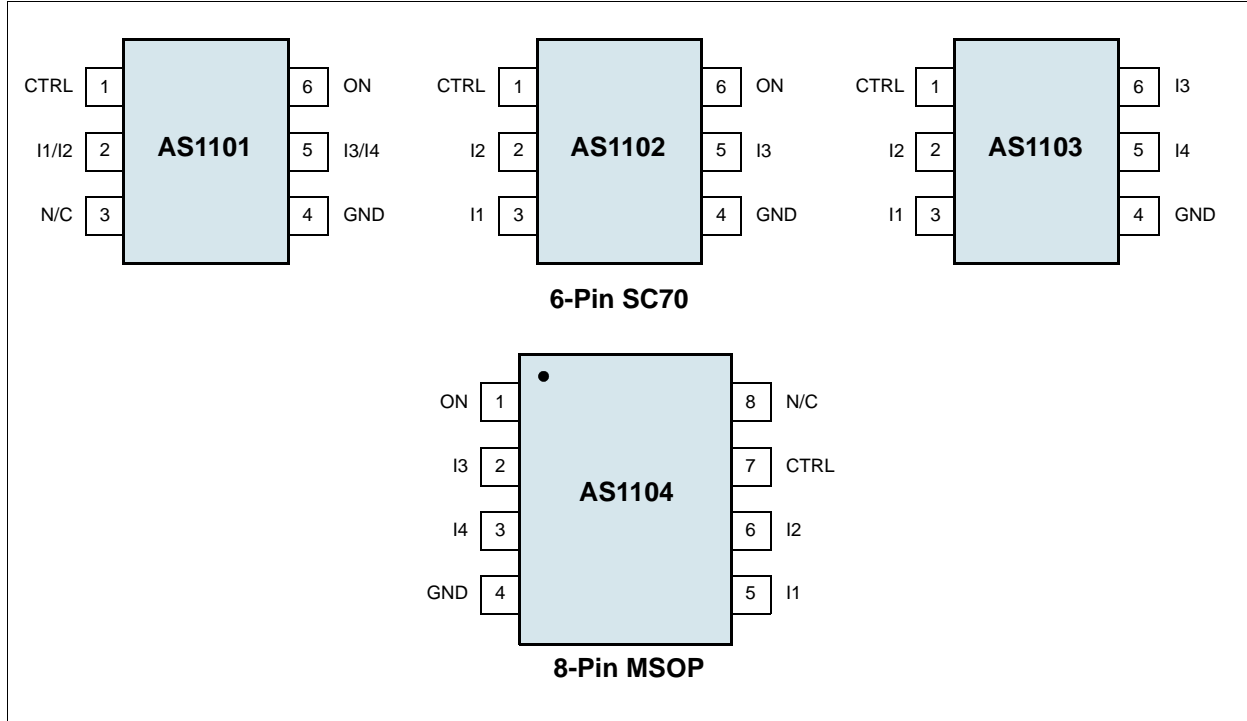
Figure 1. Typical Application Diagrams



4 Pinout

Pin Assignments

Figure 2. Pin Assignments – (Top View)



Pin Descriptions

Table 1. Pin Descriptions

| Pin Number | Pin Name | Description |
|----------------|----------|---|
| (see Figure 2) | CTRL | Sets LED current; connect to external resistor. |
| | I1 | Connect to cathode of LED. |
| | I2 | Connect to cathode of LED. |
| | I3 | Connect to cathode of LED. |
| | I4 | Connect to cathode of LED. |
| | GND | Ground |
| | ON | Device Enable Input. |

5 Absolute Maximum Ratings

Stresses beyond those listed in [Table 2](#) may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those listed in [Electrical Characteristics on page 4](#) is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 2. Absolute Maximum Ratings

| Parameter | Min | Max | Unit | Comment |
|--|------|-----|------|--|
| V _{I1} , V _{I2} , V _{I3} , V _{I4} , CTRL and ON Voltage to GND | -0.3 | 5 | V | |
| Power Dissipated by Device at T _{AMB} = 85°C | | 200 | mW | SC70-6 |
| | | 250 | mW | MSOP-8 |
| I ₁ , I ₂ , I ₃ , I ₄ Steady State Current | | 100 | mA | |
| Package Body Temperature † | | 260 | °C | |
| Junction Temperature | | 150 | °C | |
| Storage Temperature | -65 | 150 | °C | |
| Electrostatic Discharge Protection (ESD) Level | 2 | | kV | Human Body Model; Norm: MIL-STD883E 3015 methods. |

† The reflow peak soldering temperature (body temperature) is specified according to IPC/JEDEC J-STD-020C "Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices".

Operating Conditions

Table 3. Recommended Operating Conditions

| Parameter | Min | Typ | Max | Unit | Comments |
|---------------------------|------|-----|-----|------|----------|
| LED Cathode Voltage | 0.15 | 0.6 | 3.6 | V | |
| Enable Voltage ON Mode † | 2.2 | 3.0 | 3.6 | V | |
| Enable Voltage OFF Mode † | 0 | 0.2 | 0.5 | V | |
| Ambient Temperature | -40 | 25 | 85 | °C | |

† Not applicable to AS1103.

6 Electrical Characteristics

AS1101 Electrical Characteristics

$T_{AMB} = 25^{\circ}\text{C}$ (unless otherwise noted).

Table 4. Electrical Characteristics – AS1101

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|-------------------------------------|---------------|---|-----|-----|-----|---------------|
| ISET Range | ISET | $V_{ON} = 3\text{V}$ | 25 | | 150 | μA |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 25\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$ | 350 | 500 | 650 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 40\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$ | 335 | 480 | 625 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 75\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$ | 295 | 420 | 545 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 25\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$ | 435 | 620 | 805 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 40\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$ | 425 | 610 | 795 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 75\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$ | 415 | 590 | 765 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 25\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$ | 470 | 670 | 870 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 40\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$ | 460 | 660 | 860 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 75\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$ | 440 | 630 | 820 | |
| LED-to-LED Current Matching | Match | $V_{ON} = 3\text{V}$ | -3 | | 3 | % |
| ISET in OFF Mode | $I_{SET,OFF}$ | $V_{CTRL} = 3\text{V}$, $V_{SAT} = 3\text{V}$, $V_{ON} = 0\text{V}$ | | 0.1 | 1 | μA |
| IIN in OFF Mode | $I_{IN,OFF}$ | $V_{CTRL} = 3\text{V}$, $V_{SAT} = 3\text{V}$, $V_{ON} = 0\text{V}$, $T_{AMB} = 25^{\circ}\text{C}$ | | 0.1 | 1 | μA |
| | | $V_{CTRL} = 3\text{V}$, $V_{SAT} = 3\text{V}$, $V_{ON} = 0\text{V}$ | | | 4 | |
| Peak Efficiency [†] | η | $V_{IN} = 3\text{V}$, $V_{ON} = 3\text{V}$ | 95 | | | % |

[†] Efficiency = $(V_{IN} - V_{SAT})/V_{IN}$. Information parameter, guaranteed by design.

AS1102, AS1103, AS1104 Electrical Characteristics

$T_{AMB} = 25^{\circ}\text{C}$ (unless otherwise noted).

Table 5. Electrical Characteristics – AS1102, AS1103, AS1104

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|-------------------------------------|--------|--|-----|-----|-----|---------------|
| ISET Range | ISET | $V_{ON} = 3\text{V}$ | 25 | | 150 | μA |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 25\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$ | 175 | 250 | 325 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 40\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$ | 170 | 240 | 310 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 75\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$ | 145 | 210 | 275 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 25\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$ | 215 | 310 | 405 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 40\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$ | 215 | 305 | 395 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 75\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$ | 205 | 295 | 385 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 25\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$ | 235 | 335 | 435 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 40\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$ | 230 | 330 | 430 | |
| Output Current Multiplication Ratio | OCMR | $I_{SET} = 75\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$ | 220 | 315 | 410 | |

Table 5. Electrical Characteristics – AS1102, AS1103, AS1104

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|-------------------------------|----------|--|-----|-----|-----|---------|
| LED-to-LED Current Matching | Match | $V_{ON} = 3V$ | -3 | | 3 | % |
| ISET in OFF Mode ¹ | ISET,OFF | $V_{CTRL} = 3V, V_{SAT} = 3V, V_{ON} = 0V$ | | 0.1 | 1 | μA |
| IIN in OFF Mode ¹ | IIN,OFF | $V_{CTRL} = 3V, V_{SAT} = 3V, V_{ON} = 0V,$ $T_{AMB} = 25^{\circ}C$ | | 0.1 | 1 | μA |
| | | $V_{CTRL} = 3V, V_{SAT} = 3V, V_{ON} = 0V$ | | | 2 | |
| Peak Efficiency ² | η | $V_{IN} = 3V, V_{ON} = 3V$ | 95 | | | % |

1. Not applicable to AS1103.

2. Efficiency = $(V_{IN} - V_{SAT}) / V_{IN}$. Information parameter, guaranteed by design.

7 Typical Performance Characteristics

Figure 3. Set Current vs. V_{CTRL}

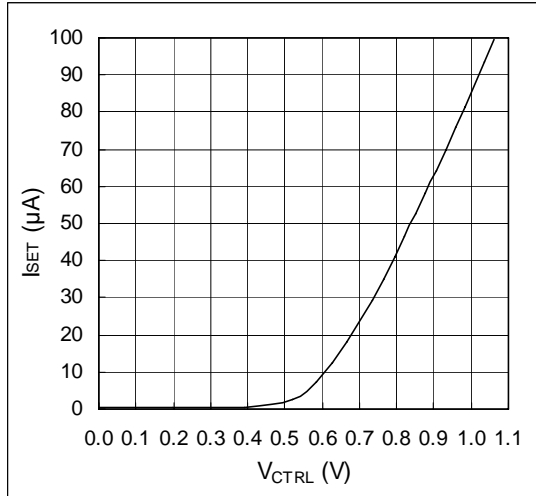


Figure 4. Set Current vs. V_{SET} ; $R_{SET} = 30k\Omega$

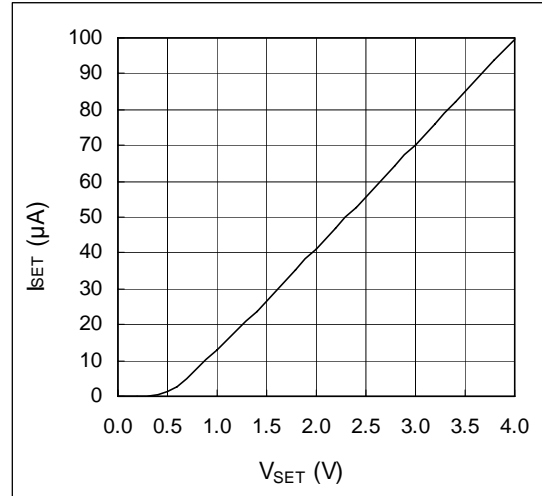


Figure 5. AS1101 I_{LED} vs. V_{SAT}

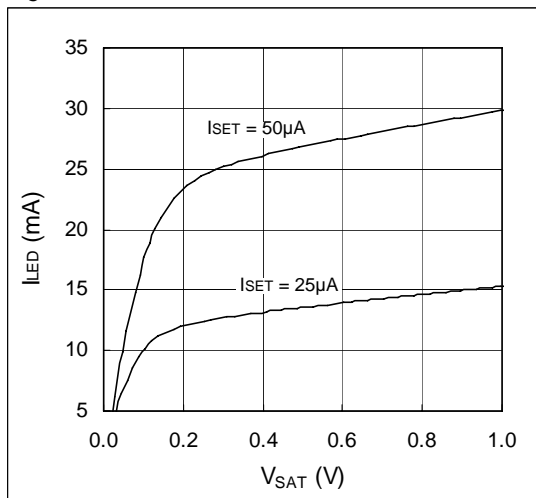


Figure 6. AS1102, AS1103, AS1104 I_{LED} vs. V_{SAT}

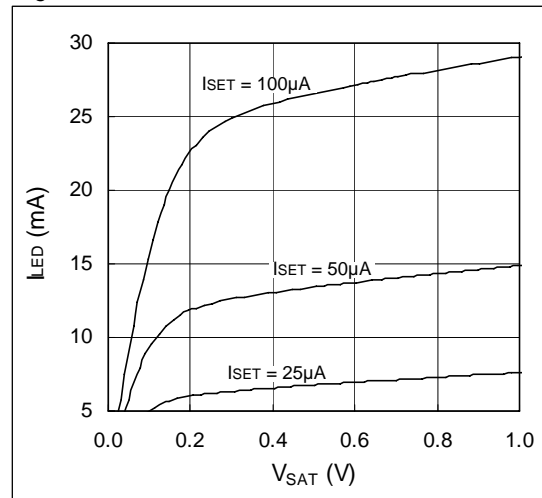


Figure 7. AS1101 $OCMR$ vs. I_{SET}

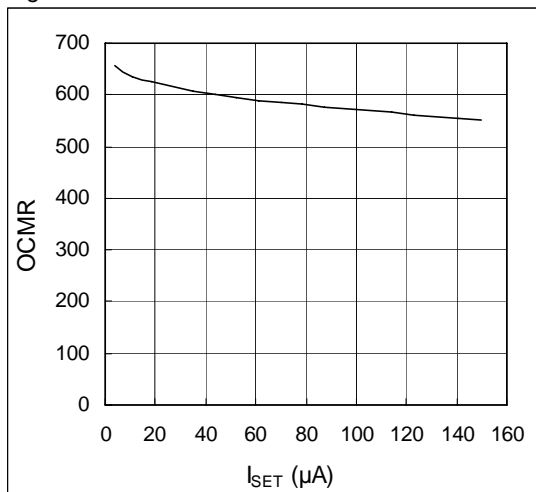


Figure 8. AS1102, AS1103, AS1104 $OCMR$ vs. I_{SET}

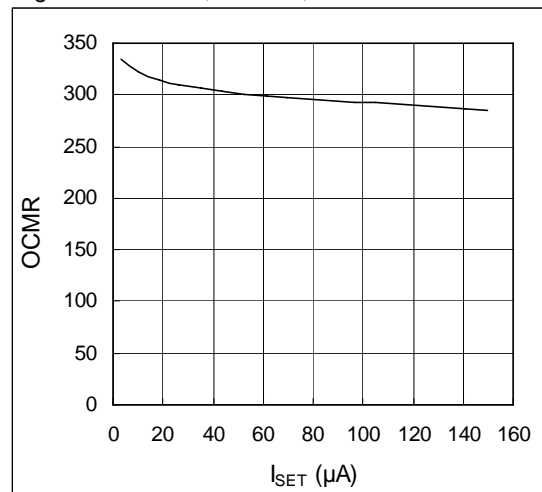


Figure 9. AS1102, AS1103, AS1104 ILED vs. RSET; VSET = 3V

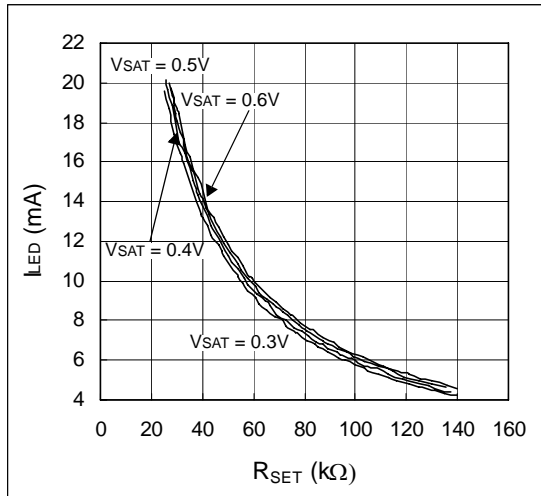


Figure 10. AS1102, AS1103, AS1104 ILED vs. RSET; VSET = 3V

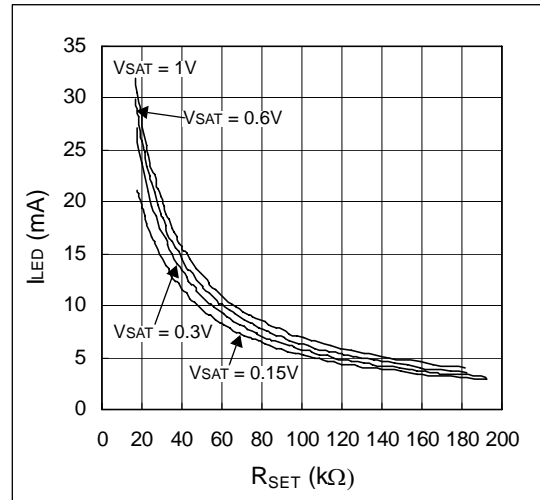


Figure 11. AS1101 ILED vs. RSET; VSET = 3V

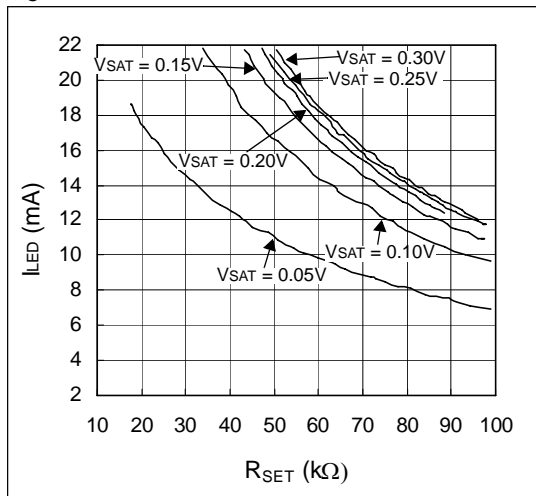


Figure 12. ILED vs. Temp; VLED = -0.25V, ISET = 50μA

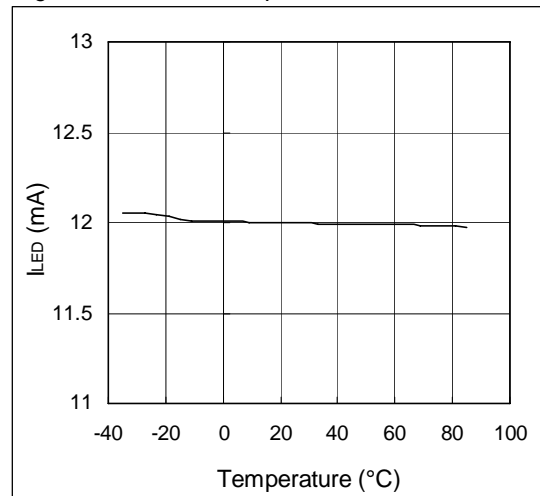


Figure 13. AS1101 ILED vs. ISET

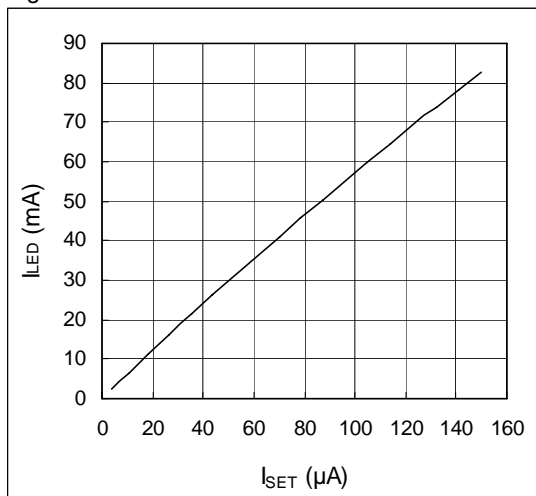


Figure 14. AS1102, AS1103, AS1104 ILED vs. ISET

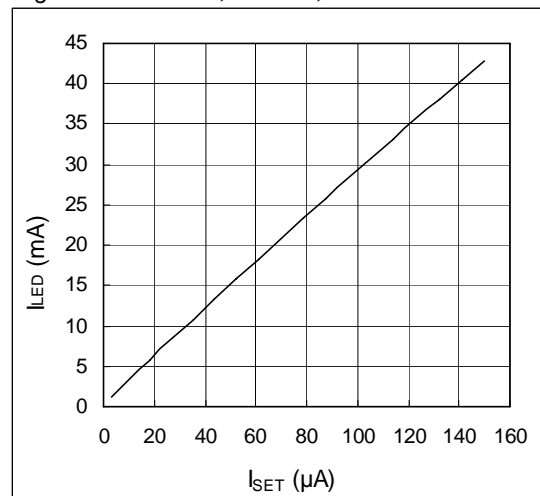


Figure 15. AS1101 vs. RSET

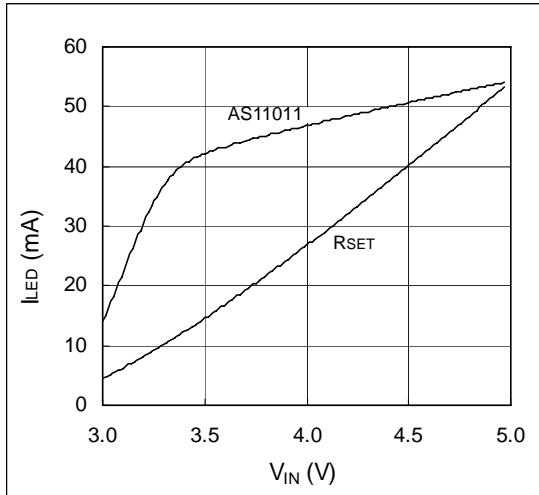


Figure 16. AS1102, AS1103, AS1104 I_{LED} vs. V_{IN}

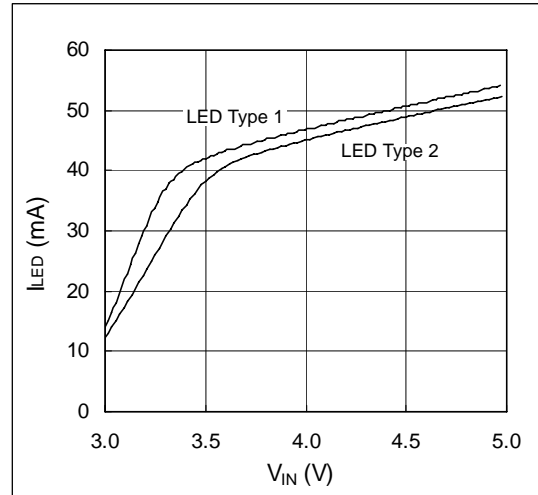


Figure 17. Control Voltage Transient Response

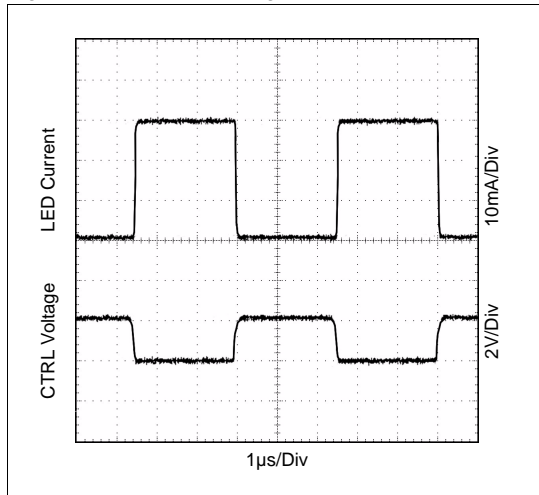
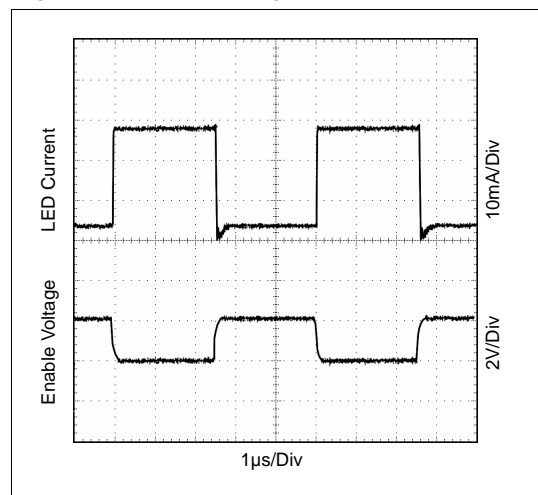
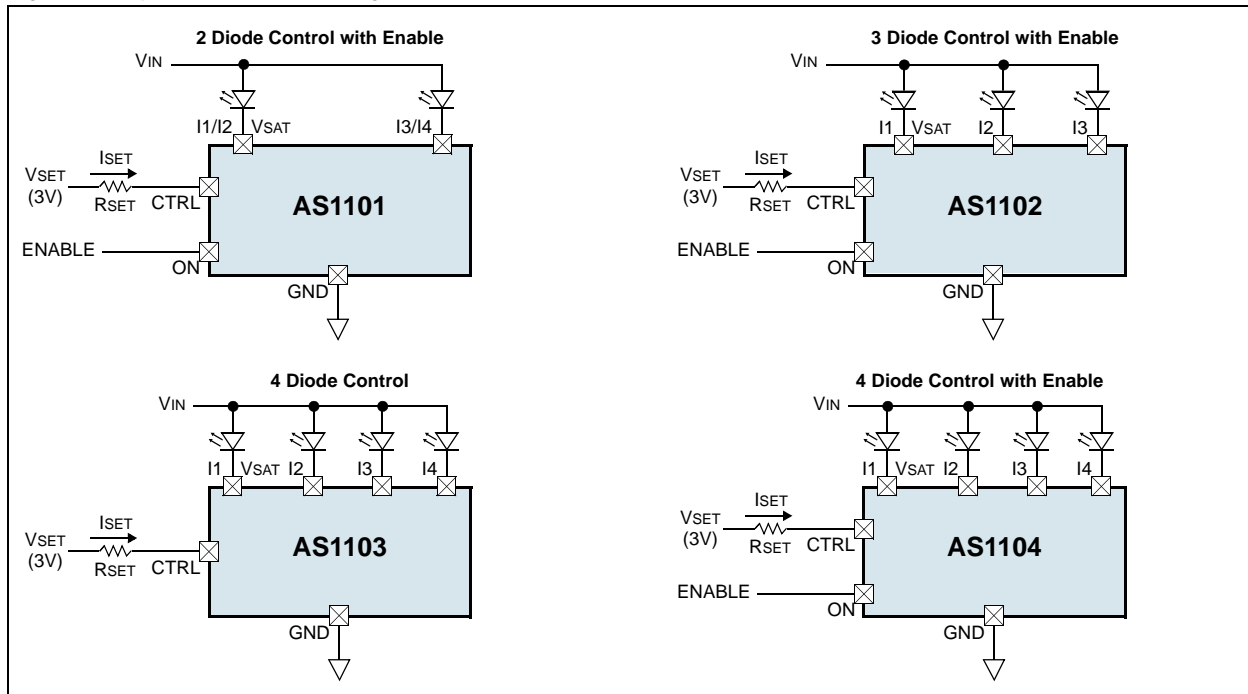


Figure 18. Enable Voltage Transient Response



8 Application Information

Figure 19. Typical Application Diagrams



Setting the LED Current

The current going into the LEDs is approximately OCMR times greater than the current ISET. LED current is controlled by VSET and RSET (see Figure 19) according to the formula:

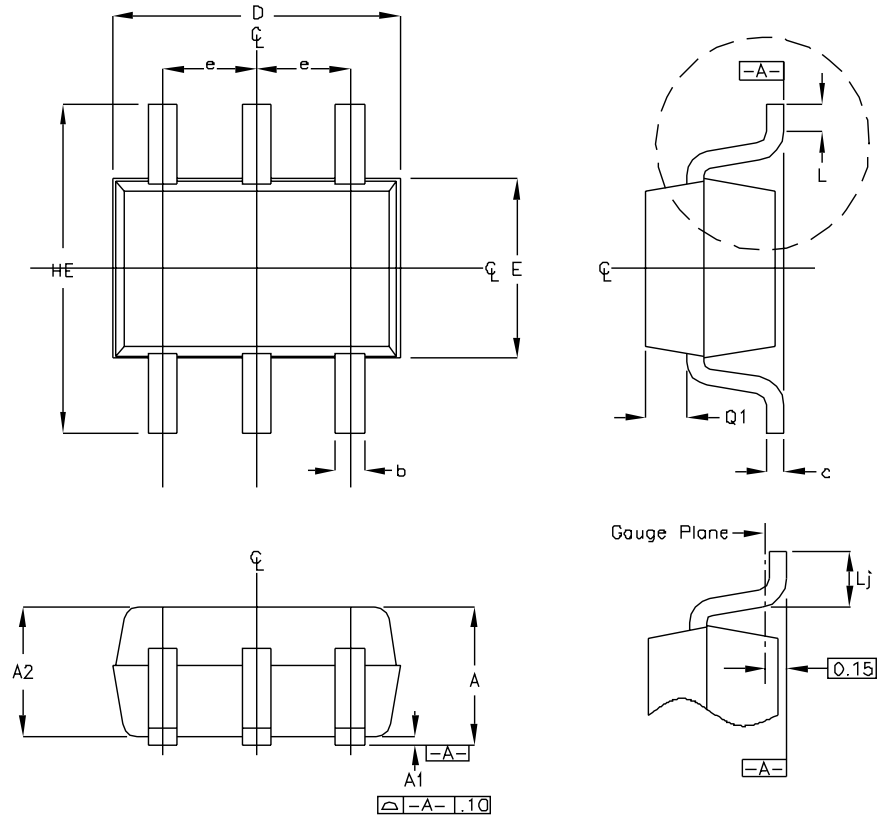
$$I_{LED} = OCMR \times (V_{SET} - V_{CTRL}) / R_{SET} \quad (EQ 1)$$

For VSET = 3V and a specific LED current, the value of RSET can be determined using the graphs shown in Figure 9, Figure 10, and Figure 11 on page 7. For any other option, the value of ISET can be determined using the graph in Figure 3 on page 6.

Note: LED brightness can also be adjusted by driving pin ENABLE or pin CTRL with a PWM signal.

9 Package Drawings and Markings

Figure 20. SC70-6 Package

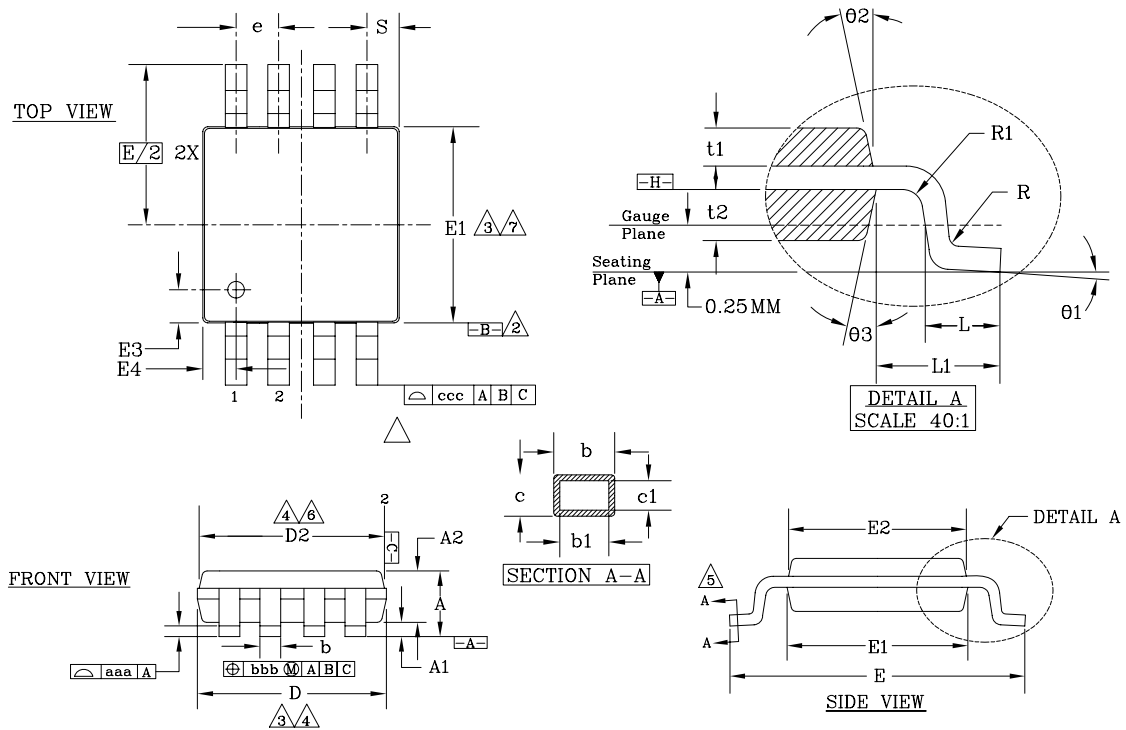


Notes:

1. All dimensions are in millimeters.
2. Dimensions are inclusive of plating.
3. Dimensions are exclusive of mold flash and metal burrs.
4. All specifications comply with JEITA SC88 and JEDEC-MO-203.

| Symbol | Min | Max |
|--------|----------|------|
| e | 0.65 BSC | |
| D | 1.80 | 2.20 |
| b | 0.15 | 0.30 |
| E | 1.15 | 1.35 |
| HE | 1.80 | 2.40 |
| Q1 | 0.10 | 0.40 |
| A2 | 0.80 | 1.00 |
| A1 | 0.00 | 0.10 |
| A | 0.80 | 1.10 |
| c | 0.10 | 0.18 |
| L | 0.10 | 0.30 |
| Lj | 0.26 | 0.46 |

Figure 21. MSOP-8 Package



| Symbol | Millimeters | ± Tolerance | Symbol | Millimeters | ± Tolerance |
|--------|-------------|----------------|--------|-------------|----------------|
| A | 1.10 | Max | b | 0.33 | +0.07 to -0.08 |
| A1 | 0.10 | ±0.05 | b1 | 0.30 | ±0.05 |
| A2 | 0.86 | ±0.08 | c | 0.18 | ±0.05 |
| D | 3.00 | ±0.10 | c1 | 0.15 | +0.03 to -0.02 |
| D2 | 2.95 | ±0.10 | θ1 | 3.0° | ±3.0° |
| E | 4.90 | ±0.15 | θ2 | 12.0° | ±3.0° |
| E1 | 3.00 | ±0.10 | θ3 | 12.0° | ±3.0° |
| E2 | 2.95 | ±0.10 | L | 0.55 | ±0.15 |
| E3 | 0.51 | ±0.13 | L1 | 0.95 BSC | |
| E4 | 0.51 | ±0.13 | aaa | 0.10 | |
| R | 0.15 | +0.15 to -0.08 | bbb | 0.08 | |
| R1 | 0.15 | +0.15 to -0.08 | ccc | 0.25 | |
| t1 | 0.31 | ±0.08 | e | .65 BSC | |
| t2 | 0.41 | ±0.08 | S | .525 BSC | |

Notes:

1. All dimensions are in millimeters (angle in degrees), unless otherwise specified.
2. Datums B and C to be determined at datum plane H.
3. Dimensions D and E1 are to be determined at datum plane H.
4. Dimensions D2 and E2 are for top package and D and E1 are for bottom package.
5. Cross section A-A to be determined at 0.13 to 0.25mm from the lead tip.
6. Dimensions D and D2 do not include mold flash, protrusion, or gate burrs.
7. Dimension E1 and E2 do not include interlead flash or protrusion.

10 Ordering Information

| Part Number | Marking | Description | Package Type | Delivery Form |
|-------------|---------|--------------------------------|--------------|---------------|
| AS1101-T | JO1 | Dual LED driver with enable. | SC70-6 | Tape and Reel |
| AS1102-T | JO2 | Triple LED driver with enable. | | |
| AS1103-T | JO3 | Quad LED driver. | | |
| AS1104-T | JO4 | Quad LED driver with enable. | MSOP-8 | Tape and Reel |
| AS1104 | | | | Tubes |

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